Crossing the Equator With Science

New Partnership Between Brazil and ARS

Though on opposite sides of the equator, Brazil and the United States are similar in many ways. The United States is the fourth largest country in the world in square miles; Brazil is the fifth. The United States has the third largest population; Brazil the fifth largest. Both countries have a diversity of climates from desert to tropical. Brazil's principal crops are corn and soybeans; so are the United States'. Soybeans are the leading agricultural export of both countries.

Brazil and the United States are also major trade partners. Brazil imports about $500 million worth of U.S. agricultural technology, products, and inputs such as nitrogen fertilizer every year, while the United States is a net importer of Brazilian agricultural commodities, mainly coffee, tobacco, beef, and orange juice.

When you add in the fact that both countries share many agricultural pests and problems—not a surprise considering they are physically connected through the land bridge of Central America—a research partnership between ARS and EMBRAPA, the Brazilian counterpart of ARS, seems like a natural.

LABEX—A Virtual Laboratory

Alberto D. Portugal, president of EMBRAPA, and Francisco J.B. Reifschneider, head of EMBRAPA's Secretariat for International Cooperation, thought so too in 1995 when they suggested the idea of a formal collaboration with EMBRAPA scientists working in ARS labs.

This was the seed that has given rise to a program called LABEX, a Portuguese term for "Virtual Lab," so named because it is without any physical lab buildings of its own, explains Silvio Crestana, the EMBRAPA scientist who is running the program.

"Brazil and the United States are natural partners. Both countries are leaders in agricultural research and technology—the United States particularly in temperate and subtropical agriculture and Brazil more so in tropical agriculture," Crestana says. "Both countries have something to gain from doing research together because the United States is more advanced in some areas like precision farming, while Brazil is ahead in other areas such as no-tillage cultivation."

Collaboration also makes sense because both countries are major trading partners, adds ARS National Program Leader for International Programs Rick Bennett, who coordinates the program for the United States.

"If Brazil is going to be buying millions of dollars of our agricultural products and technology, wouldn't it be a good idea to involve their scientists in defining joint problems and finding solutions that can help us both," Bennett says.

After 3 years of discussion, LABEX became a reality in April 1998 when the World Bank lent Brazil $2.5 million over 5 years to support the program. EMPRAPA is funding the scientists' salaries and expenses, and ARS is providing office and laboratory space, equipment, and supplies as well as colleagues and collaborators.

One of LABEX's unique aspects is that the Brazilian researchers are all senior scientists. "We are not talking about a training program at ARS for Brazilian postdocs. EMBRAPA has selected very senior scientists who will make substantial contributions," Bennett says.

Brazilian veterinarian Terezinha Padilha is in her first year of a 2- to 3-year stint conducting studies at the ARS Immunology and Disease Resistance Laboratory in Beltsville, Maryland, where she is looking for resistance to internal parasites in Angus cows. Her specific project is to look at the generation of molecules that act as communicators in the cow's immune system.

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Geneticist Jorge Luiz Loyola Dantas (left) of the EMBRAPA Cassava and Fruit Crops Research Center and physiologist Renato de Araújo Dória observe symptoms of the fungal disease yellow Sigatoka on a banana leaf.

Agricultural workers get a boost to harvest papaya plants in Itapebi County, located in the extreme-south of the State of Bahia, Brazil. Photo by Scott Bauer. (K8862-1)

Internal parasites—worms—are one of the major problems facing the beef and dairy industries in both the United States and Brazil. Worms cost these industries $2 billion a year in the United States alone and have started to build resistance to commercial anthelmintics.

In addition to her own research, Padilha acts as a conduit for exchanging information about other aspects of animal health. One of her sources is the Hazard Analysis Critical Control Points (HACCP) program, a science-based food safety program in the United States.

"Brazil is just a few years behind the United States in using HACCP on farms, but the information I have been able to send home will give us an immediate leap forward," she says. Padilha has already published several papers outlining future research needs in animal health and food safety in Brazil.

Partnership Provides Mutual Benefits

Benefits are really flowing both ways from the LABEX program, emphasizes ARS microbiologist Louis Gasbarre, who is working with Padilha. "Brazil being a more tropical country, winters are not cold enough to cause a break in the parasite population. Brazil has to deal with the problem all year round; they worm up to 12 times a year. So they have a lot of expertise to offer us," he says.

Anthelmintic resistance in beef cattle has already been seen in Brazil, while it has not yet been found in the United States. So Brazil could also provide research opportunities for U.S. scientists that Padilha may be able to coordinate "because it is just a matter of time before we have the problem here," Gasbarre points out.

There are also several diseases that are a threat to U.S. cows which have not yet appeared in the United States. "There are very limited opportunities to do research on such diseases in the United States because you don't want to introduce them here. If Brazil already has the disease, ARS experiments can be done there," Padilha says.

On the plant side, Brazilian entomologist Miguel Borges is working at the Insect Chemical Ecology Laboratory in Beltsville, Maryland, looking for ways to control stink bugs, a soybean pest in both Brazil and the United States. In particular, he is trying to determine whether genetically modified soybeans release the same semiochemicals as traditional soybean varieties to attract insects that parasitize stink bugs. Semiochemicals are chemicals released by one species to attract or repel another.

"We don't have exactly the same species in Brazil and in the United States, but we do have the same genera and the same problems of controlling insect damage without overusing chemical pesticides," Borges says.

Brazil is ahead of the United States in some aspects of insect biocontrol on farms. One reason is that insects are a greater challenge in a more tropical country; another is that biocontrol is often labor intensive and labor is less expensive in Brazil, explains Borges. "But the technology we develop can be applied in the United States as well," he says. "We understand today that we must learn together because what we have is really one global environment."

One oddity that Borges' colleague ARS entomologist Jeffrey R. Aldrich has noted is that parasitic insects native to the United States prefer to attack exotic species, including certain stink bugs from Brazil, something Borges and Aldrich hope to investigate further.

Aldrich is especially interested in working with Brazil because insects there are much more similar to those in the United States than those of Europe or Asia are. "Joint studies across an ocean are not going to be of as much benefit because we have less in common in terms of species," Aldrich says.

Brazilian agronomist Ariovaldo Luchiari has been taking advantage of the season reversal between the United States and Brazil to double his data collecting as he evaluates indicators to measure stress in corn and soybeans as part of

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With the help of a donkey, an agricultural worker transports bananas on a farm in the southern region of Bahia.

improving precision agriculture management systems. Precision agriculture systems depend on gathering specific data in a repeatable fashion from the soil and crops, using equipment connected to global information and global positioning systems.

"Precision agriculture is about shifting farming from managing strictly by observation to using unbiased scientific data to make decisions. Right now, I am comparing water and nitrogen stresses in corn to see if I can use chlorophyll fluorescence to tell me when intervention by irrigating and/or fertilizing would be truly worthwhile," Luchiari says. He is working at the ARS Soil and Water Conservation Research Unit in Lincoln, Nebraska.

Precision agriculture technology is gaining popularity in the United States and Brazil. Luchiari has been able to bring a new perspective to developing such technology and to helping Brazilian farmers put it to work. Considering Brazilian farmers may be a major market for U.S. companies that are marketing precision agriculture technology, Luchiari's work holds real significance for future trade.

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LABEX coordinator Silvio Crestana (left) and entomologists Miguel Borges (center) (of EMBRAPA) and Jeffrey Aldrich (of ARS) observe a cage of Brazilian stink bug pests, *Euchistus heros.*

Other Opportunities Abound

While LABEX is a direct arrangement between EMBRAPA and ARS, it is by no means an exclusive relationship. Since ARS has more than 100 research locations, partnering also gives the Brazilian scientists opportunities to work with a variety of U.S. universities.

LABEX has placed Brazilian molecular biologist Maria Jose A. Sampaio at ARS' U.S. Plant, Soil, and Nutrition Laboratory in Ithaca, New York, but she is working closely with Cornell University, especially the Cornell Research Foundation, the school's technology transfer and intellectual property rights arm. Sampaio is working on the complex issues of gene patenting, particularly international implications for improving biotechnology in developing countries.

Since the Uruguay Round in 1994, countries have been asked to modify their legislation to allow for the patenting of biotechnology and to provide protection for plant varieties.

Both EMBRAPA and ARS see the development of intellectual property rights as essential to giving researchers continuing access to plant germplasm and genes for agronomically important traits, while preserving the rights of the host country, the inventor of new technology, and the developer of new varieties.

"The project also provides funds for working with other intellectual property rights offices at various American universities to develop an understanding of their modus operandi and the use of proprietary assets in the transfer of technology to other public and private organizations," Sampaio says. "In the coming year, I will also be seeking more interaction with ARS' Technology Transfer Office."—By **J. Kim Kaplan,** ARS.

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Nelore breed of beef cattle in Itapebi County of Bahia, Brazil.

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EMBRAPA veterinarian Terezinha Padilha and ARS immunologist Louis Gasbarre examine Black Angus heifers used for identifying genetic resistance to internal parasites.